PAPER FEEDING APPARATUS FOR PRINTING MACHINE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of Korean Application No. 2003-57178, filed August 19, 2003, in the Korean Intellectual Property Office, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the invention:

[0001] The present invention relates to a printing machine such as a printer, a copier, and a multi-function office device. More particularly, the present invention relates to a paper feeding apparatus for supplying printing papers to an image-forming unit of a printing machine.

Description of the Related Art:

[0002] The paper feeding apparatus of a printing machine can be defined according to its structure. There are generally two distinct types; that is, : an automatic compensation pick-up system and a friction pad pick-up system. For instance, the automatic compensation pick-up system is disclosed in U.S. patent No. 5,662,364, and the friction pad pick-up system in U.S. patent No. 5,316,285, the entire contents of both U.S. patents being incorporated herein by reference.

[0003] Fig. 1 is a schematic sectional view of the automatic compensation pick-up system as disclosed in U.S. patent No. 5,662,364. In Fig. 1, reference numeral 10 represents a paper feeding tray and reference numeral 20 represents a pick-up unit.

[0004] The paper feeding tray 10 comprises a friction resistance plate 11 which is slant at a predetermined angle, and a plurality of printing papers P that are stacked in the paper feeding tray 10 with a front end in contact with the friction resistance plate 11.

[0005] The pick-up unit 20 comprises a pick-up roller 21, and a pick-up bracket 22 that supports the pick-up roller 21. The pick-up unit 20 further comprises a gear train (not shown) for transmitting a driving force generated by a driving source (not shown) to the pick-up roller 21. The pick-up bracket 22 is mounted in a main body frame (not shown) of the printing machine, with one end rotatably supported thereby. Accordingly, the pick-up roller 21 always contacts the top of the printing papers P stacked in the paper feeding tray 10 while in standby mode.

[0006] In a conventional automatic compensation pick-up system, the pick-up roller 21, which is in a contact with the printing paper P, rotates by the driving force transmitted from the driving source through the gear train. A frictional force is therefore generated between the pick-up roller 21 and the printing paper P due to the rotation of the pick-up roller 21, and the printing paper P is picked up and transferred by the friction resistance plate 11, sheet by sheet. Concurrently, the paper feeding apparatus of the automatic compensation pick-up system picks up the printing paper, automatically compensating for a vertical pressure created by the pick-up roller 21., The vertical pressure created by the pick-up roller 21 has a significant influence on the paper transfer efficiency and is directly proportional to the thickness of the printing paper P.

[0007] The paper feeding apparatus of the conventional automatic compensation pick-up system, however, maintains a regular distance between the pick-up roller 21 and the friction resistance plate 11 without regard to type of printing paper. Additionally, the angle of the friction resistance plate 11 is constant. Therefore, a relatively thick or stiff paper cannot be picked up ('no pick-up'), which causes the printer to jam. Alternatively, when the paper feeding apparatus of the conventional automatic compensation pick-up system attempts to pick up relatively thin or less stiff paper, a pick-up boundary condition occurs which is variable according to the stacked amount of printing paper, and thereby, multi-page pick-ups may occur.

[0008] Fig. 2 is a schematic sectional view of the friction pad pick-up system of U.S. patent No. 5,316,285.

[0009] As shown in Fig. 2, the conventional friction pad pick-up system comprises a

rotatable pick-up roller 31 disposed at one side of an upper part of a paper feeding tray 30 into which a plurality of the printing papers P are stacked to pick up the printing paper P. Additionally, a knockup plate 32 is mounted in the paper feeding tray 30 to lift the stacked paper P and contact the printing paper P with the pick-up roller 31 with a predetermined amount of vertical pressure. A friction pad 33 is mounted between the pick-up roller 31 and a front end of the knockup plate 32, for separating the printing paper P sheet by sheet while the printing paper P is picked up by the pick-up roller 31.

[0010] The knockup plate 32 moves up and down by an up/down device that includes a beam plate 34 and a lift plate 35.

[0011] The knockup plate 32 is moved down by the up/down device when the printing paper P needs to be replenished. Accordingly, the printing paper P can be easily replenished in the paper feeding tray 30 in a space between the pick-up roller 31 and the knockup plate 32.

[0012] When the printing papers P are completely replenished or a printing command is received by the printer, the knockup plate 32 is moved up by the up/down device, enabling the printing paper P and the pick-up roller 31 to contact each other by a predetermined amount of vertical pressure.

[0013] The pick-up roller 31 rotates as the driving force is transmitted to it, and picks up the printing paper P with the vertical pressure generated by the rising force of the knockup plate 32. The picked-up printing paper P is separated sheet by sheet by the friction pad 33 to be transferred to the printing apparatus.

[0014] The paper feeding apparatus of the conventional friction pad pick-up system, however, operates with a constant vertical pressure until pick-up of the printing paper P is completed. More specifically, the paper feeding apparatus of the conventional friction pad pick-up system does not have a vertical pressure compensation device as in the automatic compensation pick-up system as described above. Therefore, in the paper feeding apparatus friction pad pick-up system, relatively thick papers are not picked up due to lack of the vertical pressure. Furthermore, in picking up relatively thin papers, the alignment of a front end of the paper deviates since the thin papers are separated

only by frictional resistance. As a result, separate devices, such as a paper end arranging device (shown as finger 36 in Fig. 2), are provided with the paper feeding apparatus of the conventional friction pad pick-up system, which increases structure complexity.

SUMMARY OF THE INVENTION

[0015] The present invention has been made to overcome the problems of the prior art as described above. Therefore, it is an aspect of the present invention to provide a paper feeding apparatus of a printing machine adopting the advantages of an automatic compensation pick-up system and a friction pad pick-up system, which is simple in structure and capable of stably picking up printing paper regardless of the thickness thereof.

[0016] In order to achieve the above-described aspects of the present invention, there is provided a paper feeding apparatus of a printing machine comprising a paper feeding tray for stacking a plurality of printing papers therein, a pick-up unit having a pick-up roller which rotates at an upper part of the paper feeding tray to pick up the printing paper, a knockup plate moving up and down in the paper feeding tray to contact the printing paper of the paper feeding tray with the pick-up roller to lift the printing paper, and a separation member for separating the printing paper picked up by the pick-up roller sheet by sheet. The paper feeding apparatus of a printing machine further comprises a sensor for detecting a distance between the printing paper and the pick-up roller, and a lifting device for lifting the knockup plate by a signal of the sensor to maintain a constant contacting status of the printing paper and the pick-up roller.

[0017] According to an embodiment of the present invention, the pick-up unit has one end for rotatably supporting the pick-up roller, and the other end rotatably supported on the main body frame of the printing machine. The pick-up unit further includes a gear train for transmitting a driving force from a driving source to the pick-up roller.

[0018] In one embodiment of the present invention the knockup plate moves down

by a self-weight. In another embodiment of the present invention, the knockup plate comprises an extension spring mounted at a bottom surface of the paper feeding tray to elastically support the knockup plate downward.

[0019] In addition, the separation member has a separation part of predetermined height and slanting angle, which extends from a spot where the top of the stacked printing paper meets the pick-up position with the knockup plate being in an up state, having a predetermined roughness.

[0020] The separation member has an arrangement part mounted substantially perpendicularly to the bottom surface of the paper feeding tray for aligning the printing paper stacked in the paper feeding tray when the knockup plate moves down, and a separation part extending from the arrangement part, and has a predetermined angle and predetermined roughness.

[0021] The predetermined slanting angle is preferably between 100~130° with respect to the bottom surface of the paper feeding tray. Yet, it is more preferable that the predetermined slanting angle be at or about 120° with respect to the knockup plate at a paper pick-up position in which the knockup plate is lifted up.

[0022] The separation member can be formed integrally with or separately from the paper feeding tray.

[0023] Furthermore, the sensor can be a pressing sensor or a proximity sensor.

[0024] The lifting device comprises a motor which is the driving source, a cam mounted at a side of a lower part of the knockup plate and rotating by the driving force from the motor to lift the knockup plate, and a driving force transmitting means for deceleratingly transmitting the driving force of the motor.

[0025] The driving force transmitting means comprises a worm disposed at a shaft of the motor, a worm wheel engaged with the worm, a deceleration gear having the same shaft as the worm wheel, and a cam gear disposed on a rotation shaft of the cam to be engaged with the deceleration gear.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0026] These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

[0027] FIG. 1 is a sectional view illustrating the structure and operation of a paper feeding apparatus of a conventional automatic compensation pick-up system;

[0028] FIG. 2 is a sectional view illustrating the structure and operation of a paper feeding apparatus of a conventional friction pad pick-up system; and

[0029] FIG. 3 is a sectional view illustrating the structure and operation of a paper feeding apparatus according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] Hereinafter, embodiments of a paper feeding apparatus according to the present invention will be described in detail with reference to the accompanying drawings in which like reference numerals are used to refer to like features and structures.

[0031] Referring to Fig. 3, the paper feeding apparatus of a printing machine according to one embodiment of the present invention comprises a paper feeding tray 40, a pick-up unit 50, a knockup plate 60, a separation member 70, a sensor 80, and a lifting device 90.

[0032] The paper feeding tray 40 stacks a plurality of printing paper P therein. The paper feeding tray 40 can be integrally formed with a main body frame of the printing machine such as an inkjet printer.

[0033] The pick-up unit 50 comprises a pick-up roller 51 for picking up the printing paper, rotating at an upper part of the paper feeding tray 40, and a pick-up bracket 52 for supporting the pick-up roller 51. The pick-up bracket 52 has one end 52a by which the pick-up roller 51 is rotatably supported, and the other end 52b rotatably supported to the main body frame (not shown) of the printing machine. Furthermore, in the pick-up bracket 52, a gear train (not shown) is mounted for transmitting a driving force from a driving source (not shown) to the pick-up roller 51. The pick-up unit 50 as described above performs pick-up of the printing paper in the same structure and operation as the general conventional paper feeding apparatus of the automatic compensation pick-up system. The above pick-up unit 50 for the paper feeding apparatus according to an embodiment of the present invention also has a function of automatic compensation.

[0034] The knockup plate 60 is mounted in the paper feeding tray 40 to move up and down with respect to a bottom surface of the paper feeding tray 40. The printing paper P is stacked in the paper feeding tray 40, on top of the knockup plate 60. The top of the stacked printing paper P and the pick-up roller 51 contact each other as the knockup plate 60 is lifted by a lifting device 90, which is described in greater detail below. As a result of the lifting device 90 forcing the knockup plate 60 to lift the paper such that the top of the paper P stack is contact with the pick-up roller 51, a frictional force is generated between the pick-up roller 51 and the printing paper P, by which the printing paper P is picked up.

[0035] The knockup plate 60 is preferably mounted apart from the pick-up roller 51 such that a space exists for the printing paper P to be stacked therein. In one embodiment of the present invention, the knockup plate 60 can be designed to go down by weight of itself. In another embodiment of the present invention, the knockup plate 60 can be elastically biased upward from the bottom surface of the paper feeding tray 40 by an extension coil spring 100, as shown in Fig. 3.

[0036] The separation member 70 is mounted at one end of the paper feeding tray 40; this end of the paper feeding tray is at a direction that the printing paper P advances. The separation member 70 separates the printing paper P picked up by the pick-up roller 51 sheet by sheet. The separation member 70 can be formed integrally with, or

separately from, the paper feeding tray 40.

[0037] The separation member 70 has a separation part 71 of predetermined height and slanting angle of or about α, which extends from a spot where the top of the stacked printing paper P meets the pick-up position with the knockup plate 60 being in an up state. A paper contact surface of the separation part 71 has a predetermined roughness.

[0038] The separation member 70 has an arrangement part 72 mounted substantially perpendicular to the bottom surface of the paper feeding tray 40 to arrange the printing paper P stacked in the paper feeding tray 40 when the knockup plate 60 moves down. In this case, the separation part 71 extends from the arrangement part 72 at or about the predetermined angle α. The printing paper P, which is stacked in the paper feeding tray 40, is well arranged and easily picked up to the pick-up position due to the separation member 70 having the separation part 71 and the arrangement part 72, .

[0039] The slanting angle α of the separation part 71 is between about 100 to about 130° with respect to the bottom surface of the paper feeding tray 40. In one preferred embodiment of the present invention, the slanting angle α is at or about 120° with respect to the knockup plate 60 in the pick-up position (in which the knockup plate 60 moves up).

[0040] The sensor 80 is mounted at a side of the pick-up bracket 52 to detect the distance between the printing paper P and the pick-up roller 51. A pressure sensor or a proximity sensor can be used for the sensor 80.

[0041] The lifting device 90 lifts the knockup plate 60 as a result of a signal transmitted by the sensor 80 to maintain regular contact between the printing paper P and the pick-up roller 51 so that no change occurs in the contacting state of the printing paper P and the pick-up roller 51 as the printing paper P is used up.

[0042] The lifting device 90 comprises a motor 91 which is the driving source, a cam 92 mounted at a side of a lower part of the knockup plate 60 and that is rotated by the driving force from the motor 91 to lift the knockup plate 60, and a driving force transmitting means 93, for deceleratingly transmitting the driving force of the motor 91.

[0043] The driving force transmitting means 93 includes a worm 94 disposed at a shaft of the motor 91, a worm wheel 95 engaged with the worm 94, a deceleration gear 96 having the same shaft as the worm wheel 95, and a cam gear 97 disposed on a rotation shaft 92a of the cam 92 to be engaged with the deceleration gear 96.

[0044] The lifting device 90 can employ a line feeder motor (not shown) which is used for driving the printing machine, instead of a separate motor such as the motor 91 in an alternative embodiment of the present invention.

[0045] Operation of the paper feeding apparatus of the printing machine according to the present invention will be described.

[0046] As discussed above, the paper feeding apparatus according to an embodiment of the present invention is structured such that it combines the advantages of the general conventional automatic compensation pick-up system and friction pad pick-up system. In picking up relatively thick papers, the thick papers are picked up as they slide along and up the separation part 71 of the separation member 70, as shown by a dotted-line paper in Fig. 3. This operation solves the problem of a paper jam with no pick-up which occurs because of a lack of vertical pressure in the conventional friction pad pick-up system. When picking up relatively thin papers, however, a buckling of the thin paper occurs, as shown by the solid-line paper in Fig. 3, to separate the thin papers so that problems such as multi-paper pick-up does not occur. The problem of multi-paper P pick-up, and variations in the picking conditions that can occur in the automatic compensation pick-up system as the position of the pick-up roller changes according to the amount of the stacked printing paper P, are prevented. Therefore, the printing paper P can be stably picked up by the paper feeding apparatus according to the embodiments of the present invention, which will be described in greater detail below.

[0047] Knockup plate 60 is urged downward by the extension spring 100 in standby mode, and accordingly, a predetermined gap is formed between the knockup plate 60 and the pick-up roller 51 that allows stacking of the printing paper P in the paper feeding tray 40. The printing paper P is stacked with a front end thereof contacting with the arrangement part 72 of the separation member 70. Therefore, any separate device for

aligning the front end of the printing paper P is not necessary.

[0048] When a printing command is received in the standby mode, the motor 91 rotates clockwise (as viewed from the front, facing the worm 94), and the driving force thereof is transmitted to the cam gear 97 through the worm 94, the worm wheel 95, and the deceleration gear 96. As the worm 94 rotates clockwise, the worm wheel 95 and deceleration gear 96 rotate clockwise (as viewed in Fig. 3), causing cam gear 97 to rotate counter-clockwise. Cam gear 97 rotating counter-clockwise causes the cam 92 to rotate counter-clockwise as well. The cam 92, which is on the same shaft 92a as the cam gear 97, rotates counter-clockwise, causing the knockup plate 60 to be lifted up to the pick-up position where the pick-up roller 51 and the top of the printing paper P contact.

[0049] The sensor 80 at one end of the pick-up bracket 52 sends a signal to maintain the regular contact between the pick-up roller 51 and the printing paper P. Thereby, the driving force of the motor 91 is restricted to control the height of the knockup plate 60.

[0050] The driving force of the driving source (not shown) is transmitted to the pick-up roller 51 through the gear train inside the pick-up bracket 52. Then, the pick-up roller 51 rotates, picking up the printing paper P with the frictional force generated between the printing paper P and the pick-up roller 51, and the vertical pressure generated by pressure of the cam 92 and the pick-up bracket 52. The picked-up printing paper P is transferred by the separation part 71 of the separation member 70, sheet by sheet.

[0051] Thin papers are separated by being buckled, as shown by the solid line in Fig. 3, while the thick papers are slidingly separated by the friction between the paper and the separation member 70. Thick papers do not buckle between the pick-up roller 51 and the separation member 70, or buckle relatively little, because of the thick paper's stiffness.

[0052] If multiple pieces of paper are being printed, i.e., serial pick-up, the motor 91 is driven by the signal of the sensor 80 in proportion to the reduced amount of printing paper P, in order to maintain a constant pressure between the pick-up roller 51 and the printing paper P. Accordingly, the cam 92 lifts the knockup plate 60 as much as the

reduced printing paper P, maintaining a regular amount of contact between the pick-up roller 51 and the printing paper P all the time.

[0053] After the printing work is completed, the motor 91 rotates counterclockwise, and the knockup plate 60 moves down to be on the standby mode.

[0054] As described above, the paper feeding apparatus according to the embodiments of the present invention combines the advantages of a buckling separation structure to the conventional friction pad pick-up system, which uses an automatic compensation function of the conventional automatic compensation pick-up system, with the separation member 70. In addition, the embodiments of the present invention provide conditioning such that regular contact is maintained between the pick-up roller 51 and the printing paper P as a result of the sensor 80 and the knockup plate lifting device 90. Consequently, the conditions of no pick-up and a variable pick-up boundary based on the amount of stacked printing paper P can be eliminated. Furthermore, compensation of the vertical pressure and the multiple pick-up of thin papers, which are problems in the conventional friction pad pick-up system, can be prevented.

[0055] According to the present invention described above, printing papers can be stably supplied since reliability of paper pick-up is improved, thereby providing a satisfactory printing machine to users.

[0056] While the invention has been shown and described with reference to certain preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.